M. M. IMAMOV[1], *Head of the Department, Doctor of Economic Sciences, Professor, Cool921815@yandex.ru*

[1]*Institute of Management, Economics and Finance, Kazan Federal University, Kazan, Russia*

DEVELOPMENT TRENDS IN LOW-CARBON TECHNOLOGY TRANSFER BETWEEN RUSSIA AND CHINA

The article discusses the issues of low-carbon technology transfer in the oil and gas industry. The mechanism of the technology exchange in the context of import substitution is shown. It is stated that the technology exports from Russia to other countries tend to increase. At the same time, in recent years, the vector of the technology exports from Russia has shifted to the countries of Asia, the EAEU and China. It is revealed that the technology transfer is accompanied by significant risks. A model for the transfer of low-carbon technologies between Russia and China is proposed, which takes into account the peculiarities of the legislation in both countries, financial support for innovative developments, and the search for investors. The purpose of the article is to develop directions for the development of the low-carbon technology transfer from Russia to China.

Keywords: *oil and gas industry, project management, methodologies, transfer of low-carbon technologies, software*

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Introduction

The major concern of the process design in recent years is low-carbon technologies. These technologies target at climate improvement in the world and at production with the reduced carbon footprint. These technologies are being introduced in various industries, particularly, in the oil and gas industry and the power engineering. This issue is on the agenda in many countries worldwide.

The largest Russian corporations, including Rosneft, Rosatom and Lukoil, set up with this particular mission. They vigorously pursue development of new technologies to improve ecological properties of oil and gas production and to introduce eco-friendlier methods in power engineering in the country.

In present-day conditions, it seems to be the most interesting to promote mutual cooperation and team-work between China and Russia in the transfer of low-carbon technologies, and to share experience and jointly developed technologies on this basis.

So, the topicality of the issue implicates the search for an optimal model of the low-carbon technology transfer between Russia and China. The problem may lie in the presence of a huge number of risks connected with legislative controversies in both countries, financial support of technological innovations, finding of investors, etc.

This study aims at development of an effective model of the low-carbon technology transfer in cooperation between the Russian and Chinese companies.

Methods

This inter-disciplinary study involves integration of methods of the industrial, technical-and-economic and statistical analyses. The main methods used in the study are the content analysis, dynamic and structural analysis, mathematical statistics and scientific synthesis.

Results and discussion

The issues of organization and maintenance of scientific knowledge crossflow between economies of the two countries for entering new sales markets and producing new products are by no means new. Transition to the effective research management started in the 1980s and aimed at substantiation of scientific progress and at quantitative accounting of high-quality technologies in the countries.

Understanding this trend needs comprehending the notion and essence of the technology transfer addressed by scientists from different points of view. Mostly, the technology transfer correlates with the notions of innovations which have multiple aspects and include high technologies and breakthroughs in many sectors of economy [1].

According to V. V. Dmitrienko's viewpoint, the technology transfer can match up with R&D implemented in a specific country and transferred to other countries subject to certain conditions [2]. On the other hand, according to V. A. Kirisheva [3], the technology transfer aims at modernization of industry and its branches which are now underdeveloped.

There also other approaches to understanding transfer of technologies.

For instance, researcher N. V. Sopina [4] represents the technology transfer as a core of efficient performance of an innovative economy and a country's technological upgrade in all kinds and forms. The researcher addresses this point via the comparison of the high-tech export dynamics in Russia (**Fig. 1**).

In recent years, the pace of the technology transfer has greatly increased. And Russia has changed the vector toward the countries of Asia, EAEU and China.

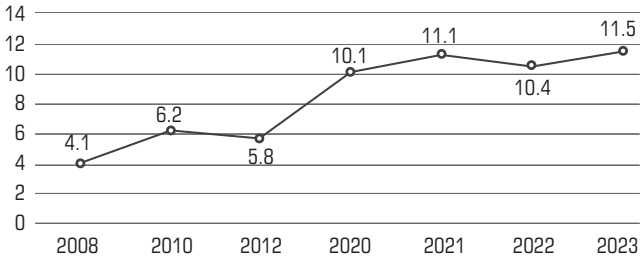

Fig. 1. Dynamics of export of technologies from Russia to other countries of the world, billion USD [5]

Russia and China have joined with the center of technological cooperation, which ensures the mutual technology transfer between them. The ample investments in the research in this area allow the countries to get to a next level of development and to balance some technological lag from other countries.

China creates full-fledged *low-carbon cities* in the areas from the list of the most polluted towns in the world [6]. The strategies of improvement of low-carbon economy infrastructure are introduced in these cities.

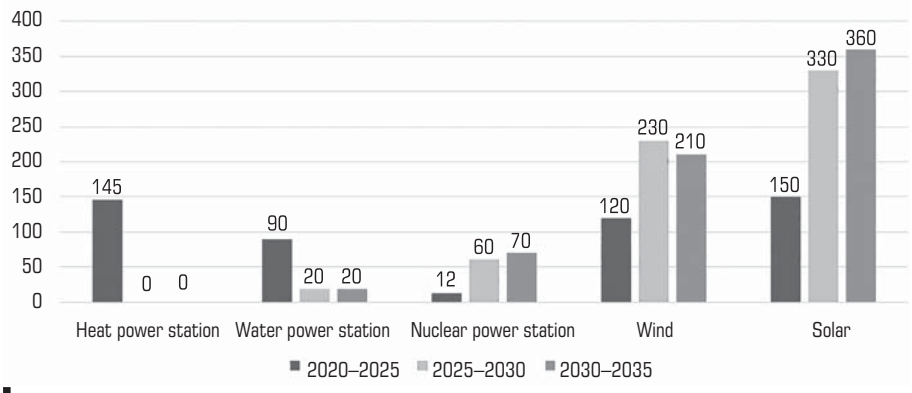

Fig. 2. Distribution of generating capacities by types of generation in PRC, GW [7]

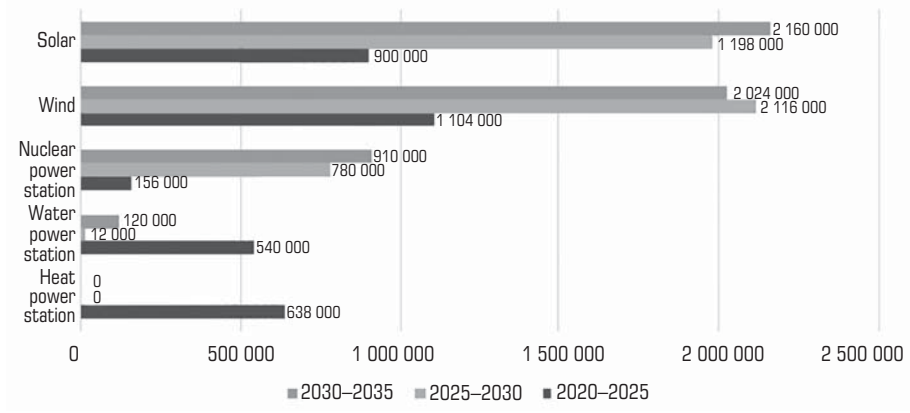

Fig. 3. Expected investment of China in low-carbon power engineering, million CNY [7]

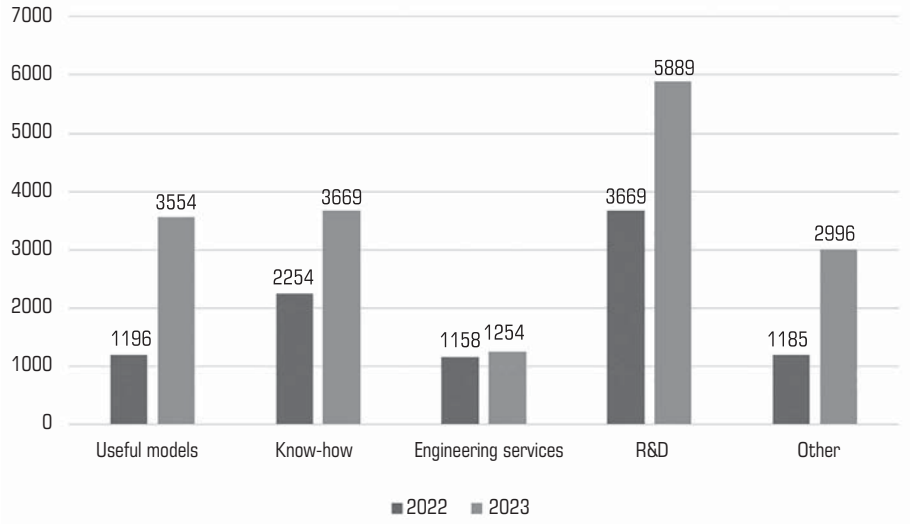

Fig. 4. Number of agreements concluded on low-carbon technologies in the last 2 years between Russia and China [9]

While implementing low-carbon projects, PRC strives for a gradual transition to the nuclear power engineering to replace conventional heat and water power stations. The plans of distributing generating capacities by the types of generation for the time periods in future are depicted in **Fig. 2**.

Evidently, China plans to increase the number of wind and solar power stations only to supply homeownerships. On the other hand, the alternative sources can hardly ensure full-scale power supply of large production facilities. The expected investment of China in the low-carbon power engineering is described in **Fig. 3**.

Clearly, investments are mostly distributed between the alternative low-carbon technologies of power generation, including nuclear, wind and solar power stations [8].

This also proves the innovative cooperation between the countries as Russia and China maintain an active exchange of technologies in the fields of know-how, R&D and useful models. The number of agreements concluded between Russia and China in the sphere of low-carbon technologies within the last 2 years is depicted in **Fig. 4**.

Current Megaprograms on the transfer of technologies is one of the most effective tools used by China in the transfer of low-carbon technologies from Russia. At present time, China implements many Megaprograms and supports the top-priority trends of scientific development and attraction of new technologies in China.

This mechanism was for the first time evaluated in introduction of a long-term development plan in China in 2006 [10]. Within that project, many pilot experimental Megaprograms were started with a focus on the technologies and commercial products in the highest demand in China.

Nowadays Russia is put in the situation of limited access to the cutting-edge technologies and can utilize China's experience of formation of such Megaprograms.

The Chinese science plus engineering experiment demonstrated efficiency in 2016 when its preliminary results were summarized, with putting into operation aircraft engines, deep water research, national cybersecurity, smart production, robotechnics, new technologies of artificial intelligence and many other things [11]. This program fits in in the EAEU standards and in the One Belt–One Way strategy [12]. **Figure 5** describes the mechanism of the low-carbon technology transfer Megaprogram.

China–Russia Energy Cooperation Committee is a major agency to coordinate the interaction of Russia and China in the sphere of power engineering.

The Expert Committee for Low-Carbon Technologies focuses on the development and introduction of this-type technologies.

Each party has representatives that discuss various trends of energy cooperation between the countries.

Implementation of the projects involves participants of Megaprojects, research institutions, R&D centers, regional authorities and representatives of business. These are the scientific institutes, which develop new

technologies, and the business, which commercializes the low-carbon energy projects [13].

Presentation of projects is a process when the participants lay down their ideas and implementation proposals.

Project selection means assessment and selection of the most promising low-carbon power engineering projects for the support and implementation.

Implementation and approval of projects is a final stage when the selected projects are developed commercially, and the results are tested and analyzed for the further development and introduction of low-carbon energy technologies [14].

The objectives and functions of all actors are described in **Table 1**.

Each project or model should have an economic efficiency evaluation to prove expediency of introduction [15].

According to this procedure, at the stage of a project expertise via an integrated analysis, it is advisable to use a scoring to distinguish between five groups of projects. The groups are described in **Table 2**.

In this manner, the presented way of project ranking can allow evaluating projects and revealing the higher-priority projects as early as the preliminary estimation stage.

Then, the sets of parameters are to be subjected to scoring [16].

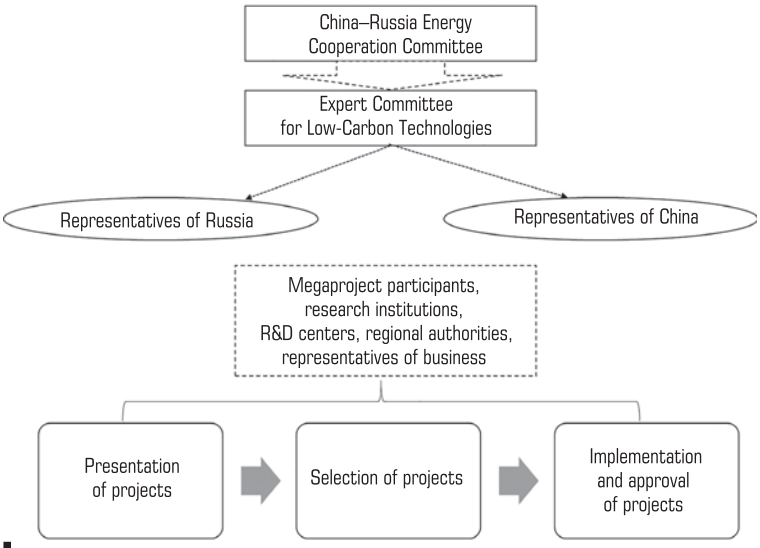

Fig. 5. Model of Megaprogram on transfer of low-carbon technologies

Using the presented parameters, an estimation matrix is constructed to identify the highest priority projects [17].

Megaprograms on the transfer of low-carbon technologies are economically feasible both in China and Russia. Furthermore, they can be extended to the projects on the technology transfer in the wind and solar power engineering where China is a large exporter [18].

The benefits are additional investment in the national economies thanks to implementation of Megaprojects [19].

Table 1. Objectives and functions of actors of Low-Carbon Technology Transfer Megaprogram

Actor	Objectives	Functions	Results
Expert Committee for Low-Carbon Technologies	Coordination of programs, shaping of an objective, determination of target parameters	Carrying out of expert examination of projects, setting of priorities. Selection of top-priority projects, determination of target efficiency, distribution of functional in the selected projects	Development of the highest priority and maximally efficient projects connected with low-carbon technologies
Project teams from universities	Presentation of projects and validation of their efficiency	Presentation in front of the expert commission, description of the target efficiency indicators, validation of the admissibility and top priority of projects	Detailing and implementation of a project, practical application and approval, getting of grants
Individual development contractors	Presentation and defence of projects, validation of efficiency, finding of project team	Presentation in front of the expert commission, description of the target efficiency indicators, validation of the admissibility and top priority of projects	Detailing and implementation of a project, practical application and approval, getting of grants
Regional authorities	Provision of land and property for allocation of scientific basis of a project, negotiation of public–private partnership contracts	Provision of R&D project team with resources, proper equipment of premises and facilities. Lodging of presentations, forums and other events in the framework of the Megaprogram	Provision of comfortable and convenient conditions for scientific activities of project teams inside the regions
Investors	Financial support of projects	Evaluation of project efficiency and effecting of financing contracts	Financing of R&D projects, having a final result, participation in patent support

Table 2. Grouping of innovative projects

Project group	Development area	Cost	Risks	Financing source
Top priority	Renewable energy sources	High	Medium	Public–private finance
High priority	Intelligent energy supply networks	Medium, low	Low	Totally public and public–private finance
Medium priority	Smart production systems in low-carbon power engineering	Medium, low	Low	Totally public and public–private finance
Low priority	Robotics, novel AI technologies	High	High	Public–private finance
No priority	Other areas connected with low carbon energy	High	High	Public–private finance

Source: compiled by the author.

Table 3. Cost-to-use analysis of the proposed model of Russia–China Megaprojects on low-carbon technology transfer

Index	2021	2022	2023
Number of unimplemented projects in low-carbon power engineering in Russia	88	110	150
Total investment made by China and Russia, million USD	500	600	800
Percentage of efficient projects, %	30	38	40
Estimated level of project implementation using the proposed mechanism, %	30	38	40
Total economic effect, million USD	150	228	320

Efficiency can be evaluated from the formula:

$$Ep = (Q \times I) \times F,$$

where Ep is the economic efficiency of Megaprojects; Q is the number of unimplemented projects; I is the total investment made by China and Russia, million USD; F is the estimated level of implementation of projects in case of the introduction of the proposed mechanism, %.

By estimates of IMEMO RAS, in recent 5 years, there are some Megaprojects on the low-carbon technology transfer, which remain unimplemented by China and Russia [20]. Implementation of the projects could enable introduction of novel technologies with taking relevant economic advantages. The cost-to-use analysis of the proposed approach is given in **Table 3**.

To sum up, the introduction of the mechanism of Megaprojects can allow increasing the number of implemented projects up to 800 projects yearly, which can elevate investment by 320 million USD annually. The volume of investment will grow year by year, which will have a beneficial effect on technological innovation in the sphere of low-carbon technologies. The use of such mechanisms in the other fields of power engineering (wind and solar energy) will stimulate and promote the technology exchange between Russia and China to the advantage of both countries.

Conclusions

The research has shown that oil and gas technologies being developed should be in a greater degree aimed at reduction of carbon impact exerted by the conventional technologies (oil, gas and coal) on ecology. This will ensure the wanted power generation at the minimized impact on climate and nature in large industrial regions. To this effect, the Megaprogram on the transfer of low-carbon technology between China and Russia is proposed to be implemented by the Hefey-City scenario. At the same time, Russia has its own peculiarities and priorities. The peculiarity is the implementation of the projects in remote mineral-producing and power-generating mono-towns.

The presented Megaprogram mechanism involves Russian and Chinese participants, regional authorities of the areas where the research centers are to be arranged, as well as investors and project teams from both China and Russia. Special commissions will evaluate and select the best and most relevant projects of low-carbon energy engineering.

The economic efficiency calculation shows that the Megaproject mechanism when introduced can increase the annual project implementation and the related investment up to 80 projects and 320 million USD, respectively.

The described solutions can promote the low-carbon technology program in Russia and in China owing to implementation of Megaprojects that facilitate achievement of the preset goals.

References

1. Shibanov V. E., Shneyder O. A. Taxes and free economic zones: Russian practice and China experience. *Proceedings of the Voronezh State University of Engineering Technologies*. 2016. No. 2 (68). pp. 262–268
2. Dmitrenko V. V., Saybel N. Y. Technology transfer in Russia and abroad. *Juvenis Scientia*. 2016. No. 2. pp. 104–105
3. Kirisheva V. A., Gavrilyuk E. S. Characteristics of the technology transfer system of the Russian Federation. *Scientific Journal NRU ITMO. Series: Economics and Environmental Management*. 2021. No. 3. pp. 170–179.
4. Sopina N. V., Bliznova A. S., Bykova A. A. Development and regulation of technology transfer in education. *Creative Economy*. 2021. Vol. 15, No. 3. pp. 695–710.
5. Kostin K. B., Khomchenko E. A. Improving the efficiency of Russian entrepreneurship based on foreign experience in international technology transfer. *Voprosy innovatsionnoy ekonomiki*. 2021. Vol. 11, No. 2. pp. 729–744.
6. Export of Technologies from Russia. Available at: https://clk.li/zhkL (accessed: 18.08.2025).
7. Energy Profile of China. Available at: https://www.eeseaec.org/energetika-azii-i-okeanii/energeticeskij-profil-kitaa (accessed: 18.08.2025).
8. Lu Shuchen. China's Economic Cycles: Investigation Report. Pekin : Social Science Academic Press, 2006. 424 p.
9. Chzhan Y. Formalization of the Russian–Chinese economic partnership and cooperation in climate economics. *Journal of Economics, Entrepreneurship and Law*. 2025. Vol. 15, No. 6. pp. 3863–3884.
10. Bakhtiyarova A. Zh. China's Energy Policy in the Early 21st Century. *Molodoy ucheniy*. 2016. No. 9(113). pp. 967–970.
11. Bagdasaryan N. A., Belyakov G. P., Batukova L. R. The experience of strategic planning for scientific and technological development in China and its application in Russian practice. *Rossiya: tendentsii i perspektivy razvitiya*. 2020. No. 15-2. pp. 33–39.
12. Khotimskiy K. V. The Belt and Road Initiative and the EAEU: Prospects for Development. *Innovatsii I investitsii*. 2018. No. 2. pp. 106–109.
13. Feng J. Scientific and innovative aspects of Russian and Chinese experience in the field of strategic planning. *Modernization. Innovation. Research*. 2021. Vol. 12, No. 2. pp. 128–144.
14. Potravny I. M., Yashalova N. N. Ecologo-economic assessment of burial technologies for greenhouse gas emissions in underground geological spaces. *Gornyi Zhurnal*. 2022. No. 8. pp. 90–94.
15. Potravny I. M., Novoselov A. L., Novoselova I. Yu., Pelmeneva A. A. Factor analysis of oil and gas projects in the Arctic areas with regard to risk. *Gornyi Zhurnal*. 2023. No. 12. pp. 64–68.
16. Vasiltsov V. S., Yashalova N. N., Novikov A. V. Climate and environmental risks in the development of arctic coastal territories. *Arctic: Ecology and Economy*. 2021. Vol. 11, No. 3. pp. 341–352.
17. Novoselova I. Yu., Petrov I. V., Novoselov A. L. Arctic coal: Methodological issues of an integrated risk assessment. *Ugol*. 2020. No. 8. pp. 88–91.
18. Shihverdiev A. P. Project Management: A Monograph. Syktyvkar : Izdatelstvo SGU im. Pitirima Sorokina, 2019. 162 p.
19. Panuwatwanich K., PantouvakisJ. P. Digitalization and engineering management for the next-era industries. *Journal of Engineering, Project, and Production Management*. 2023. Vol. 13(3). ID 0017.
20. Zubenko V. V., Zubenko V.A., Sun Yu. Russian–Chinese cooperation in the sphere of digital economy. *Humanities and Social Sciences. Bulletin of the Financial University*. 2023. Vol. 13, No. 3. pp. 86–93. EM